6(b). EXPERIMENT M-3, IN-FLIGHT EXERCISER

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SUMMARY

The response of the cardiovascular system to a quantified workload is an index of the general physical condition of an individual. Utilizing mild exercise as a provocative stimulus, no significant decrement in the physical condition of either of the two astronauts could be detected during the Gemini V mission. The rate of return of the pulse rate to pre-exercise levels, following in-flight exercise periods, was essentially the same as that observed during preflight baseline studies.

OBJECTIVE

The objective of Experiment M-3 was the day-to-day evaluation of the general physical condition of the flight crew with an increase in time under conditions of space flight. The basis of this evaluation was the response of the cardiovascular system (pulse rate) to a calibrated workload.

EQUIPMENT

The exercise device (figs. 6(b)-1 and 6(b)-2) consisted of a pair of rubber bungee cords attached to a nylon handle at one end and to a nylon foot strap at the other. A stainless steel stop-cable limited the stretch length of the rubber bungee cords and fixed the isotonic workload of each pull. The device can be utilized to exercise the lower extremities by holding the handle fixed and pushing with the feet, or to exercise the upper extremities by holding the feet fixed and pulling on the handle. The flight bioinstrumentation system (fig. 6(b)-3) was utilized to obtain pulse rate, blood pressure, and respiration rate. These data were recorded on the onboard biomedical tape recorder and simultaneously telemetered to the ground monitoring stations.

PROCEDURE

The device used in the Gemini V mission required 70 pounds of force to stretch the rubber bungee cords maximally through an excursion of 12 inches. Exercise periods lasted for 30 seconds, during which time the astronaut pulled the handle of the exerciser through a full excursion once per second. Exercise periods (medical data passes) were scheduled approximately three times a day for each crew member. Blood pressure measurements were made before and after each exercise period. In addition, the command pilot, who was without pulsatile leg cuffs (Experiment M-1), was encouraged to exercise his legs between the scheduled periods.

RESULTS

The flight crew performed the exercise periods as scheduled. Heart rates were determined by counting 15-second periods for 2 minutes before and after exercise, and the first and last 15-second periods during exercise. Comparison of one-g preflight exercise periods with those obtained during flight indicated little difference in heart-rate response. Comparison of the in-flight exercise periods from the first to the last day also indicated little difference in heart-rate response. In-flight heart-rate responses are graphically illustrated in figure 6(b)-4 for the command pilot, and in figure 6(b)-5 for the pilot. Blood pressure measurements, before and after exercise periods, were generally not remarkable. In both the command pilot and the pilot, postexercise systolic pressures tended to be higher than the pre-exercise values. Postexercise diastolic pressures were generally slightly higher than or identical to pre-exercise values; rarely, they were slightly lower. The pulse pressure of the pilot tended to be significantly wider (160-130/60-70) than that of the command pilot (130-110/70-80). After the fourth day of flight, both crew members used the exerciser frequently between scheduled medical data passes. Both felt that exercise is essential and beneficial on flights of long duration.

CONCLUSIONS

The M-3 experiment on Gemini V was successfully performed. On the basis of the data obtained during this mission, the following conclusions appear warranted:

(1) The response of the cardiovascular system to a calibrated workload is relatively constant for a given individual during space flights lasting 8 days.

(2) The crew are able to perform mild to moderate amounts of work under the conditions of space flight and within the confines of the Gemini spacecraft, and this ability continues essentially unchanged for missions up to 8 days.

(3) Using a variant of the "Harvard Step Test" as an index, no decrement in the physical condition of the crew was apparent during an 8-day mission, at least under the stress of the relatively mild workloads imposed in this experiment.

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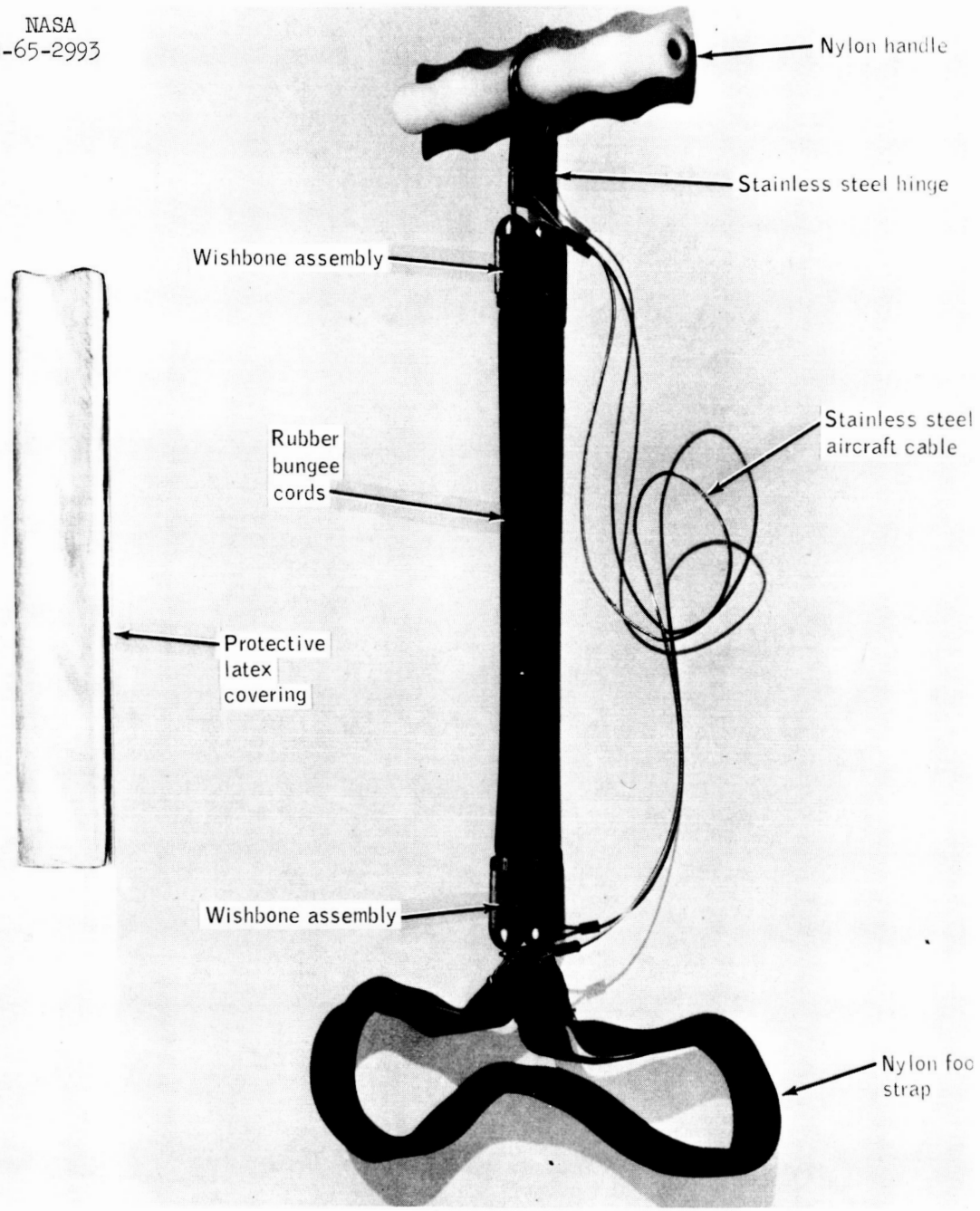

Figure 6(b)-1.- In-flight exerciser major components.

Figure 6(b)-2.- In-flight exerciser in use by an astronaut.

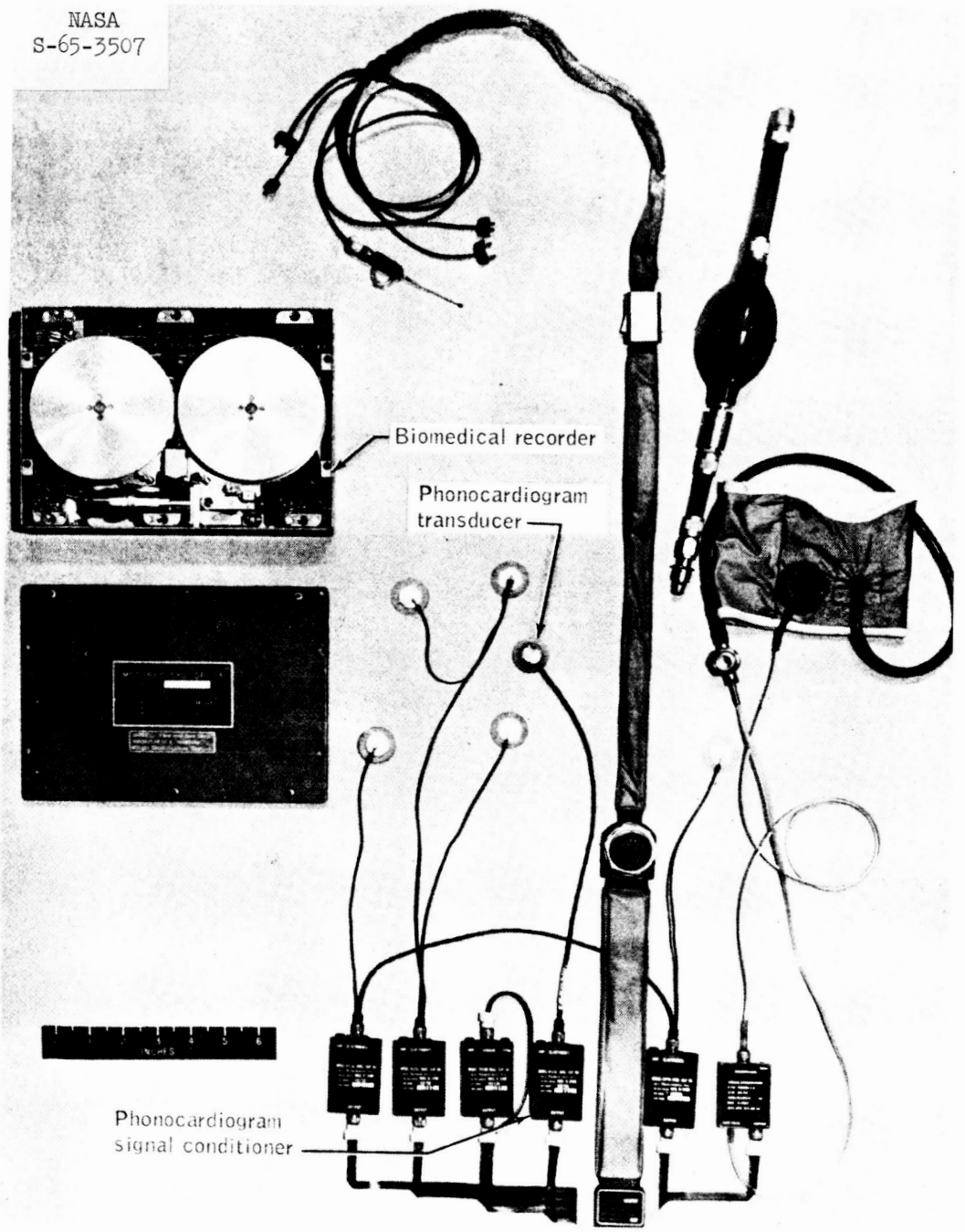

Figure 6(b)-3.- Gemini V biomedical and communications harness.

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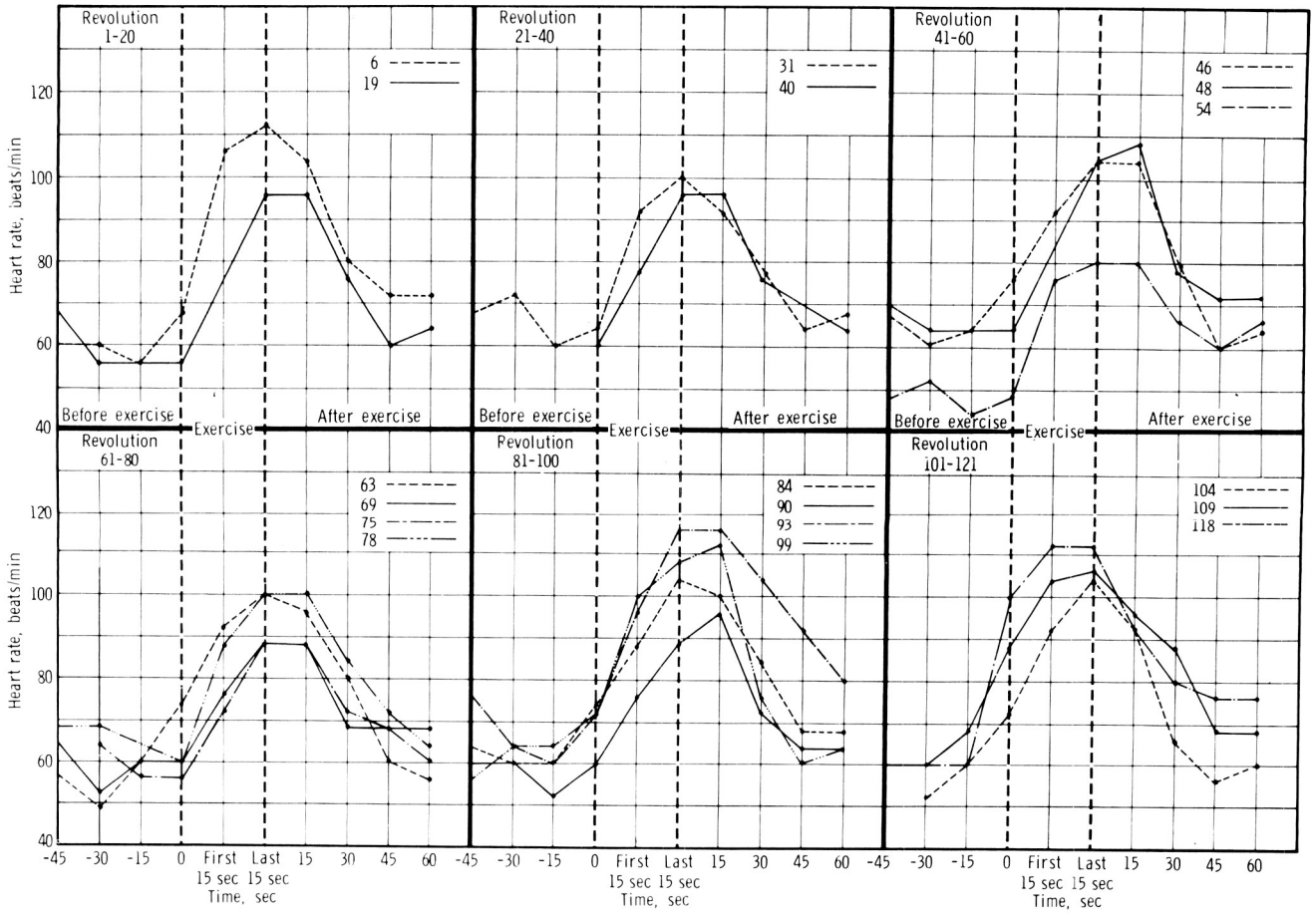

Figure 6(b)-4.- Command pilot in-flight heart-rate responses.

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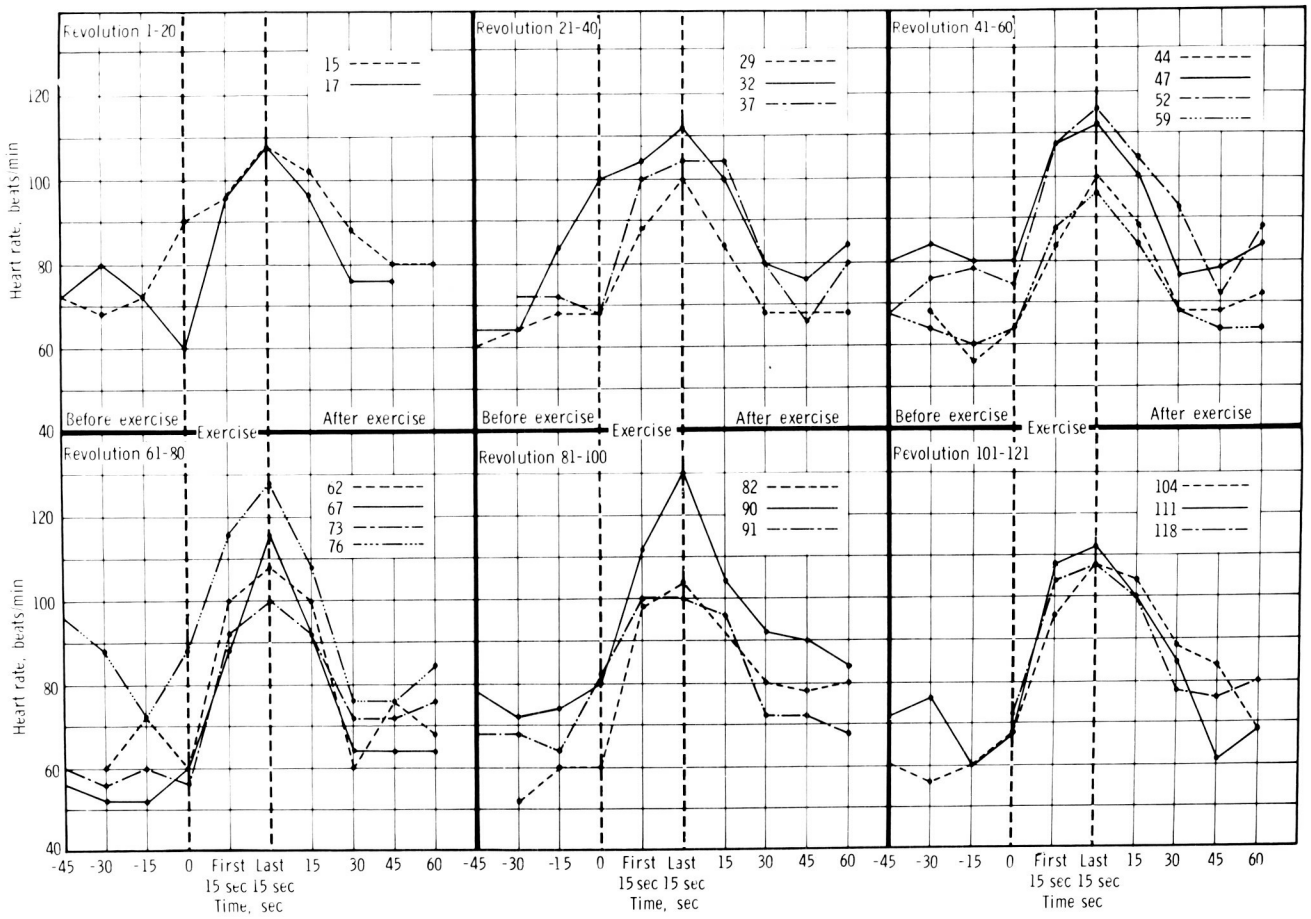

Figure 6(b)-5.- Pilot in-flight heart-rate responses.